NATURAL ENVIRONMENT RESEARCH COUNCIL

SCIENTIFIC SERVICES

OPERATIONS REPORT OF A DEMONSTRATION THEMATIC MULTISPECTRAL SCANNER SURVEY OF 18 SELECTED AREAS OF THE UNITED KINGDOM

Telephone: (01) 953 6161
Telex: 23517 HUNBOR G
Cable: ASTEREO BOREHAMWOOD

Hunting Geology and Geophysics Ltd
Elstree Way
Borehamwood
Hertfordshire WD6 1SB

Project 210 214 December 1982

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SUMMARY

The Natural Environment Research Council, Scientific Service Division on 27th August, 1982 commissioned the flying and acquisition of Thematic Scanner data over 18 selected areas of the United Kingdom where ground research projects by University and NERC units were being conducted.

The contract was limited to a 20 day period, during which time data was acquired over all 18 selected sites in accordance with contractual and technical specifications.

The aircraft chosen for this contract was a Scottish Aviation Twin Pioneer owned and operated by Flight One Limited under contract to Hunting Geology and Geophysics Limited, London.

The following sectionalised report describes the field operation and equipment in detail.

PART I

OPERATIONS REPORT

1. INTRODUCTION

The Thematic Scanner Survey described in this report was carried out by Hunting Geology and Geophysics Limited on behalf of the Scientific Services Division of Natural Environment Research Council (NERC) of Swindon, Wiltshire. The areas surveyed totalled 18 as detailed in Purchase Order F3/G6/172 of 27th August 1982 and outlined in Text Figures 1 through 5.

A Scottish Aviation Twin Pioneer aircraft supplied and crewed by Flight One Limited, fitted with a survey camera and a Daedalus AADS1268 Thematic Scanner flew the contracted areas between 10th and 21st September, 1982.

The following report describes in detail the acquisition aspects of this first AADS1268 survey in the United Kingdom.

2. INVOLVED PERSONNEL

NERC Co-ordinator and Contractual Representative:

Dr. David Williams

Flight One Limited:

Captain/Pilot	-	H. Thompson
Navigator	-	J. Allenson
Aircraft Engineer	-	J. Kay

Daedalus Enterprises Inc:

AADS1268 Engineer/ Operator	-	J. Lehotsky

Hunting Geology and Geophysics Limited:

Field Project Leader/ Survey Photo Navigator	-	J. Cook
" " "	-	A.G. Warren (part-time)
Operations Manager	-	R.D. Williams

3. FLYING OPERATIONS

3.1 Aircraft and Operational Bases

The survey was flown throughout using a Scottish Aviation Twin Pioneer Aircraft, registration G-AZHJ based mainly at Baginton (Coventry) Airport, with one landing at Conington (Peterborough) Airport, when weather conditions deteriorated during transit to a survey area.

3.2 Flying Specification and Weather Tolerances

In general the areas to be flown were in two blocks collectively called the Norwich Area and the Swansea Area. By virtue of their diverse situations and with 2 further areas in the centre of the U.K. Coventry was chosen as the base. This base gave the flying crews the shortest transits to any area and the best options on available weather conditions, with a prevailing west to east weather movement forecast.

The specifications for height, haze, cloud and flight direction were laid down by NERC prior to commencement of flying programme (Table 1). These were continually subject to alteration by the client in the light of prevailing weather conditions, directly related to the maximum contractual availability of the scanner equipment, namely 20 days. The finally achieved flying acquisition details are as follows:-

TABLE 2

Area No:	Name	Height (M)	Direction	Ground Speed (K)	No. of Runs
2i	Chepstow	800	NE	100	1
2ii	Thetford	800	E	"	1
22	Bristol Channel	12,300(ft) & 4000 M	N & S	"	7
24	Windermere	800	NW	"	2
25i	Gower	2000	E & W	"	3
25ii	Tawe Valley	1000	SW	"	1
25iii	Crai	2000	SW	"	1
26	Lathkilldale	1100	W	"	3 inc.reflie
34	Wymondham	2000	E & W	"	4
39i	Severn Estuary	2000	SW	"	2
39ii	Wash	2000	NW/SE	"	2
40	Norton Lindsey	2000	N	"	2
4/41i(a)	Shapwick A	2000	E & W	"	4
4/41i(b)	" B	800	NW/SE	"	4
4/41ii	Gedney Hill	2000	NE/SW	"	6
4/41iii	Chatteris	4000	NE/SW	"	8
4/41iv	Strumpshaw	4000	NW/SE	"	5
43i	Broads	4000	N & S	"	4
Ht Test	Conington A/F	3000 to 500 in 500 steps	E	"	6

3.3 Navigation

Other than standard aircraft navigation aids which included D.M.E.,V.O.R., and a radio compass no specific navigation equipment was installed in the survey aircraft. A survey navigator provided by Hunting used these navigation aids plus visual navigation to position the survey lines. A super wide angle survey camera was installed and used on all scanner lines flown, and maintained a forward overlap of 60% throughout the survey flying.

3.4 Survey Timing, Progress and Serviceability

The following is a summary of events:-

1982 September

2nd	Daedalus equipment arrived UK (L.A.P.)
3rd	Equipment cleared customs at 1530 hours
4/5th	Equipment collected from LAP and delivered to flying contractor's base at Shobdon Airfield.
	Daedalus engineer arrived U.K.and a Briefing meeting was held.
6th	Installation of equipment in aircraft with an air test at 1700 hours. Test flight duration approx. 30 mins.
7th	Transit of aircraft and crew to Baginton (Coventry) Airport and set up of office and dark room at airport.
8/9th	Weather prevented productive flying. Airport set up continued. Dr. D. Williams, NERC, visited aircraft base on 9th.
10th	Area 2ii Thetford, flown all other areas weathered out.
11th	Areas 26 Lathkilldale, 34 Wymondham, 4/41iv Strumpshaw, 43i Broads, were flown.
12th	Weather prevented productive flying, Processing of Quick Look film undertaken on site.
13th	Flew to area 4/41iii Chatteris, only to find weather had closed in. Landed at Conington Airfield and awaited weather window. Finally flew area 4/41iii and 4/41ii Gedney Hill (in part only).
14th	Areas 2i Chepstow, 22 Bristol Channel, 25ii Tawe Valley, 25iii Crai, 4/41i(b) Shapwick B were flown.
15th	Weather prevented productive flying. Processing of Quick Look film undertaken on site.
16th	Areas 25i Gower, 39i Severn Estuary, 40 Norton Lindsey (Birmingham), 4/41i(a) Shapwick A were flown.
17th	Area 26 Lathkilldale reflown, with ground field research party on station.
18th	Areas 39ii The Wash amd 4/41ii Gedney Hill flown. Area 24 was open weatherwise but ground research team not on station.
19/20th	Weather prevented productive flying. Processing of Quick Look film undertaken on site.

1982 September

21st Area 24 was flown on the understanding that the field party on station.

Contract flying terminated on completion of this area.

22nd/23rd Demobilisation of Coventry base, return of equipment to Leavesden Airport with aircraft for dismantling and custom check out. Aircraft returned to home base p.m. 23rd.

24th Daedalus engineer departed U.K. a.m. Equipment to LAP and final customs check out.

25th Equipment flown out of UK a.m.

During the whole of this period the aircraft and camera were fully serviceable. One minor fault on the digitiser unit of the scanner affecting channel 10 on 13th flying was reported, this was on runs 2 and 3 of area 4/41iii. Air/Ground/Air radios were provided from 8th September to aid aircrew/ground crew flying planning. These proved to be unsuccessful and only one fleeting contact was made, this was with a Swansea University boat unit on the Severn Estuary.

4. EQUIPMENT

4.1 Survey Camera

The camera used on this project was a Wild RC9 superwide angle survey camera. This camera is a manually controlled time unit well suited to provide the variable forward overlap required including stereo cover. The camera was installed in the forward camera hole of the survey aircraft and produced black/white images in a 9" x 9" format. The camera was fitted with a Wild 8.85 SAS 65 3.5 inch focal length lens. All processing of survey film was carried out in the Photographic Laboratories of Hunting Surveys at Borehamwood. 60% stereo forward overlap was flown on all areas. The scale of photo cover varies area to area due to variable flying heights.

4.2 Airborne Thematic Mapper

The equipment chosen for this NERC contract was a Daedalus Enterprises Inc. AADS 1268 ATM 11 channel scanner.

This complete sensor unit comprises a scan head, spectrometer and digitiser coupled in, on this survey, to a AADS 1840 HDDT to B/W film conversion unit, a HDDT playback unit and a Sangamo Sabre III tape recorder model 3630 1" machine.

This combination of units enabled on site production of HDDTs and Quick Look 5" wide negative film of any one selected channel.

Scan speeds of 12.5 and 25 scans/second were chosen for the areas flown and an "S" bend correction was applied to all areas flown except 4/41i, ii,iii,iv.

The operating wavelengths and performance parameters for the AADS 1268 ATM are:-

TABLE 3

Channel Band Edges in μm	12.5 scans/sec. NER[1]	25 scans/sec. NER[1]
0.42 - 0.45	0.41	0.63
*0.45 - 0.52	0.12	0.16
*0.52 - 0.60	0.071	0.087
0.605- 0.625	0.10	0.14
*0.63 - 0.69	0.081	0.087
0.695- 0.75	0.075	0.087
*0.76 - 0.90	0.074	0.082
0.91 - 1.05	0.067	0.079
*1.55 - 1.75	0.048	0.066
*2.08 - 2.35	0.027	0.031
*8.5 - 13.0	0.07°C	0.086°C

* Thematic Mapper Bands, except thermal band broadened for aircraft operation.

1. Noise Equivalent Radiance in w x 10^{-7} cm^{-2} nm^{-1} sr^{-1}.

Instantaneous Field of View (IFOV) ..... 2.5 mrad (1.25 mrad optional

Digitised Field of View ..... 85.92° (2.5mrIFOV)

It should be noted that this field of view reduces to 72° when the S Bend correction is applied.

Scan Rates ..... 12.5 and 25 scans/sec

Velocity/Height Ratio ..... 0.031; 0.062 radians/sec. corresponding to 12.5; 25 scans/sec., respectively (2.5mr IFOV)

Roll Correction ..... ± 15°

Infrared Reference Source ..... 2 controllable thermal blackbodies with a temperature range of - 15°C to +50°C with respect to sca head heat sink temperature.

Figure 6 outlines the functional operations of both the scanner head and the spectrometer.

4.3 Radio Communication Units

4 SMC 317L6 3 watt 6 channel 2 way units were supplied to assist in Air/Ground movements during proposed area survey period.

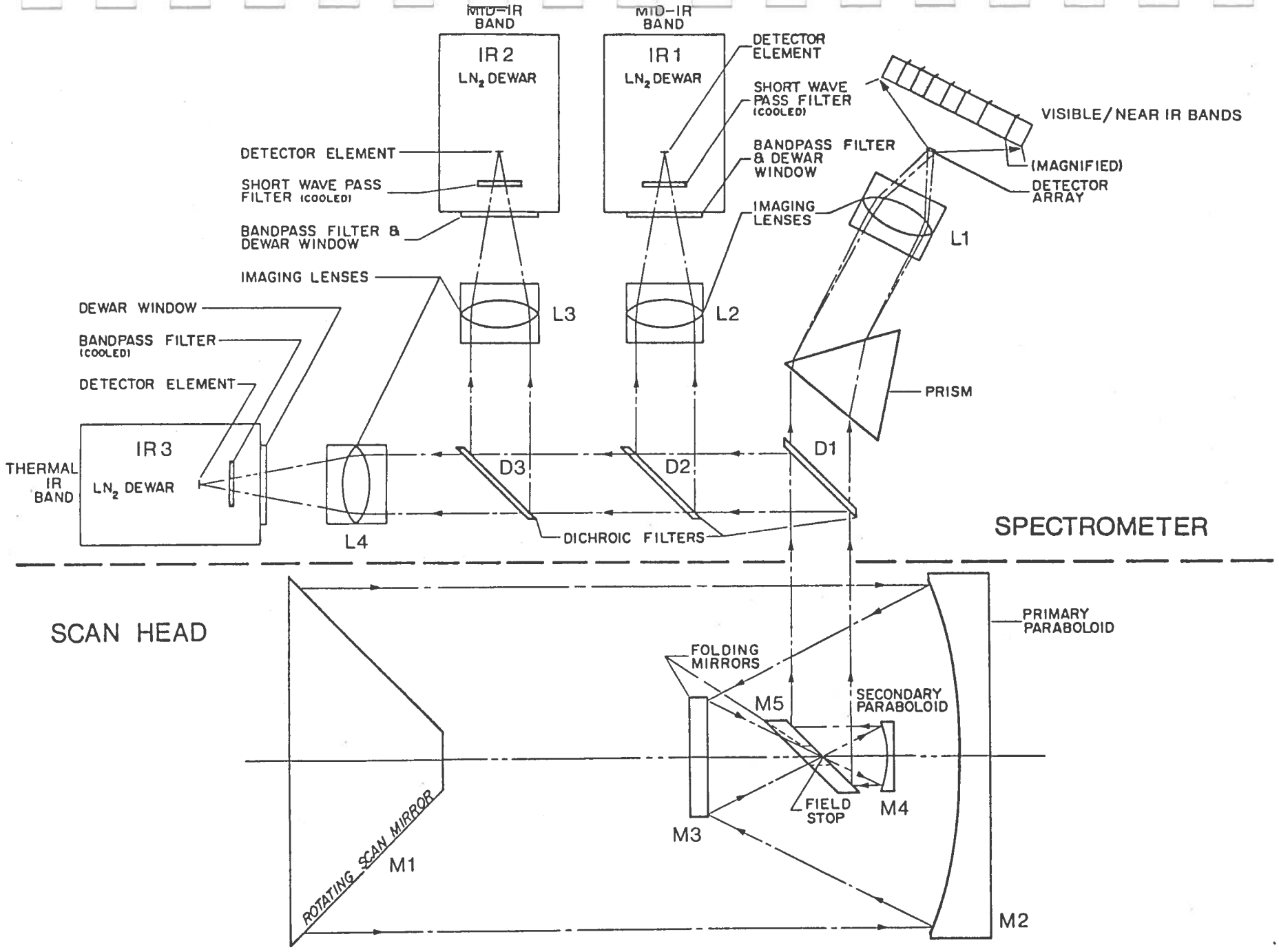

MID-IR BAND
IR 2
LN2 DEWAR
MID-IR BAND
IR 1
LN2 DEWAR
DETECTOR ELEMENT
SHORT WAVE PASS FILTER (COOLED)
BANDPASS FILTER & DEWAR WINDOW
VISIBLE/NEAR IR BANDS
(MAGNIFIED)
DETECTOR ARRAY
IMAGING LENSES
L1
DETECTOR ELEMENT
SHORT WAVE PASS FILTER (COOLED)
BANDPASS FILTER & DEWAR WINDOW
IMAGING LENSES
L3
L2
DEWAR WINDOW
BANDPASS FILTER (COOLED)
DETECTOR ELEMENT
PRISM
IR 3
LN2 DEWAR
THERMAL IR BAND
D3
D2
D1
L4
DICHROIC FILTERS
SPECTROMETER
SCAN HEAD
PRIMARY PARABOLOID
FOLDING MIRRORS
M5
SECONDARY PARABOLOID
FIELD STOP
M4
M3
ROTATING SCAN MIRROR
M1
M2

FIGURE 6

These radios were tuned to frequency 169.275 Mhz a previously licenced and allocated frequency of the Hunting Group.

5. DATA ACQUIRED AND PRESENTED

5.1 On-site

High Density data tapes (HDDTs) and one "Quick Look" channel of data in black/white negative form were produced progressively on-site. The HDDTs were carried forward on a sortie to sortie basis until total capacity used.

9"x 9" B/W survey photography in negative form was also produced on all scanner lines over land falls and shallow water.

5.2 Final Presentations

The HDDTs have been converted, and recompiled into uncorrected CCTs and duplicates, all produced by Daedalus Enterprises Inc. in Ann Arbor, Michigan. A total of 63 master and 63 duplicate CCTs cover the areas surveyed, with 1 CCT covering the Conington airfield height test flights.

The Quick Look selected channel has initially been printed as uncorrected Black and White prints and subsequently produced as corrected B/W negative film and prints.

The survey 9"x 9"film has been printed and presented in both original negative and print form. Atotal of 591 prints cover the areas surveyed.

5.3 CCT Format

Tape 0.5 ins x 2400 feet

Format	:	NASA Universal Tape Format TR 453 band interleaved by line.	
Density	:	1600 b.p.i.	Tracks 9
Byte Size	:	8 bits	Channels 11 per line flown and recorded in the following manner:-

The tape is written on a 9 track, 1600 BPI, odd parity CCT contained on a standard 10½" reel. The basic word size for the header and ancillary data is 2 bytes and is organised as shown:

MSB		LSB
1 2 3 4 5 6 7 8		9 10 11 12 13 14 15 16
Most Significant Byte		Least significant Byte
	WORD	

The tape will begin with a header record of 3060 bytes followed by the ATM scanner data. The tape is split into two flight lines; therefore, the lines will be separated by a single end of file (EOF) mark followed by a new header record. The end of the last line on the tape will be marked with two or more EOFs.

The tape will contain up to 3200 scan lines of data for each of the eleven channels. The data are organised as "data sets" which follow a header. A header is always written as the first record on tape and may also appear again during the CCT, but only after an EOF mark. A "data set" is defined as a set of three records containing all eleven channels of ATM data corresponding to a single scan line. Each record in the "data set" will be 2340 bytes long and will contain the ATM data written in line interleaved form. The structure of each record of the resulting CCT is shown in Figure 7. The record number is always one for the first record of the "data set" and, therefore, after each header the second byte of each record will start with 1 and repeat in a 1, 2, 3, 1, 2, 3, ... pattern. The ancillary data block is repeated each "data set". Bytes 5 through 68 indicate the channel numbers active (0=active) with byte 5 corresponding to channel 1, byte 6 to channel 2, etc. Table 5 lists the information that is contained in each header. This information is either in binary or EBCDIC form:

Table 4

Primary Channel #	Spectral band in µm
1	0.42 - 0.45
2	0.45 - 0.52
3	0.52 - 0.60
4	0.605- 0.625
5	0.63 - 0.69
6	0.695- 0.75
7	0.76 - 0.90
8	0.91 - 1.05
9	1.55 - 1.75
10	2.08 - 2.35
11	8.5 - 13.0

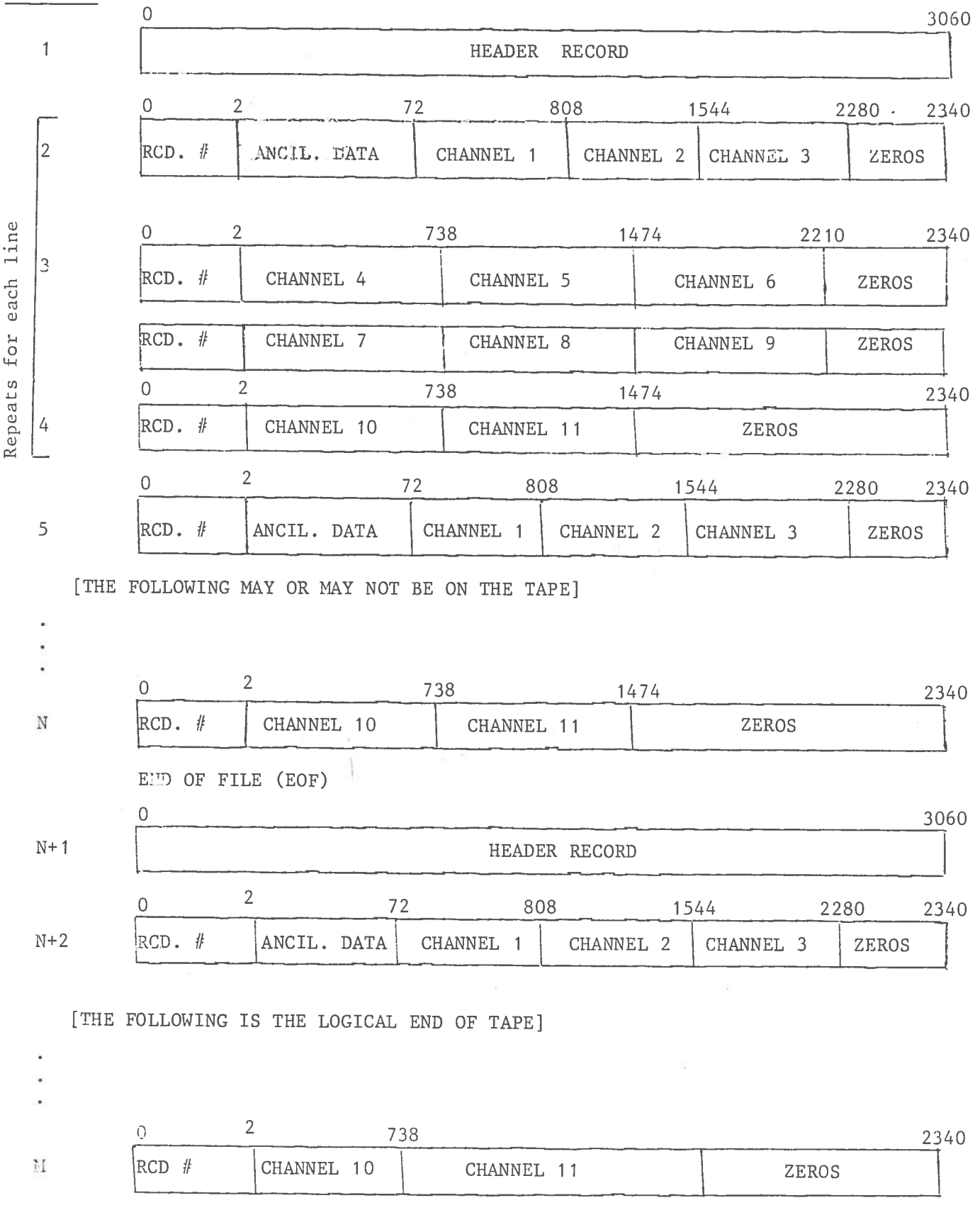
The data in each scan line are represented by 736 (8 bit) bytes. The video is contained in 716 bytes while the calibration, or housekeeping, data are contained in an additional 20 bytes. The calibration data are logically divided into two areas containing 19 and 1 byte(s), respectively. The information contained in these areas is detailed in Figure 6.

TABLE 5. HEADER STRUCTURE

BYTE #	DESCRIPTION
1-32	EBCDIC - DAEDALUS ENTERPRISES AADS1268
33-53	EBCDIC - (FLIGHT ALTITUDE)
54-60	EBCDIC - (ESTIMATED GROUND SPEED)
61	(DATE - DAY)
62	(DATE - MONTH)
63	(DATE - YEAR)
64-80	NOT APPLICABLE
81	ACTIVE CHANNELS 1 THROUGH 8 (1=ACTIVE) - CH #1=MSB
82	ACTIVE CHANNELS 9 THROUGH 16 (1=ACTIVE) - CH #9=MSB
83	NOT APPLICABLE
90	11 (NUMBER OF CHANNELS ON THIS TAPE)
91	8 (NUMBER OF BITS IN PIXEL)
92-93	20 (BYTE LOCATION OF START OF VIDEO WITHIN SCAN DATA)
94-95	1 (BYTE LOCATION OF 1st CALIBRATION AREA)
96-97	716 (NUMBER OF PIXELS IN SCAN)
98-99	19 (NUMBER OF CAL. ELEMENTS IN 1st CALIBRATION AREA)
100-101	2340 (RECORD SIZE IN BYTES)
102	3 (NUMBER OF CHANNELS PER RECORD)
103	NOT APPLICABLE
104	3 (NUMBER OF RECORDS PER DATA SET)
105-106	70 (LENGTH OF ANCILLARY DATA IN BYTES)
107	1 (LINE INTERLEAVED)
108-109	20 (1st PIXEL #)
110-111	735 (LAST PIXEL #)
112-1778	NOT APPLICABLE
1779-1780	736 (BYTE LOCATION OF 2nd CALIBRATION AREA)
1781-1782	1 (NUMBER OF ELEMENTS IN 2nd CALIBRATION AREA)
1783-1784	NOT APPLICABLE
1785-1786	3 (NUMBER OF CHANNELS IN 1st RECORD OR DATA SET)
1787-1788	736 (NUMBER OF ELEMENTS PER SCAN PER CHANNEL)
1789-1796	NOT APPLICABLE
1797-2940	FILL ZEROS
2941-3000	EBCDIC (SITE #, SITE NAME, LINE #, FLIGHT DIR., FLIGHT TIME)
3001-3060	FILL ZEROS

NOTE: All information is binary-right justified in field except Bytes 1-60 and 2940-3000 which contain EBCDIC coded information.

FIGURE 7



END OF FILE (EOF) ---- THIS IS THE LOGICAL END OF TAPE

FIGURE 7. CCT TAPE STRUCTURE

6. MATERIALS SUPPLIED TO CLIENT

6.1 Survey Film

A total of 591 9" x 9" B/W survey photographs covering all 18 areas flown have been supplied.

6.2 Quick Look Imagery

Uncorrected negative film and B/W prints in 5" wide strips, along all lines flown were produced from the field equipment.

Corrected B/W prints and film of selected channels, namely 7 and 3, were later also supplied.

6.3 CCTs

A total of 64 master CCTs covering all areas flown including Conington Airfield height calibration flying have been supplied.

A duplicate set of 64 CCTs have also been supplied.

6.4 Flight Maps

A full set of 1:50,000 scale Ordnance Survey mapsheets with recovered flight line plots of each area flown have been supplied.

6.5 Operations Report

Five (5) copies of a report of operations have been supplied.

PART II

DETAILS OF AREAS SURVEYED

DETAILS OF AREAS SURVEYED
NERC 1982 SURVEY

Area No. and Name	2i Chepstow	Map Sheet Nos.	162, 171
Flying Height (metres)	800	Direction Flown	NE
Flight Conditions	very hazy	No. of Lines	1
No. of 9"x 9"photo prints	11	No. of Scan Lines	3700
Film Forward Overlap (%)	60	No. of CCTs	1
Ground Speed (knots)	100	Scan Speed rps	25
Time Flown (GMT)	1622-1626	Tape Footage	188
Research Team Availability	-	"S" Bend Correction	Yes

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

Area No. and Name	2ii Thetford	Map Sheet Nos.	143, 144
Flying Height (metres)	800	Direction Flown	E
Flight Conditions	clear	No. of Lines	1
No. of 9" x 9" photo prints	7	No. of Scan Lines	3900
Film Forward Overlap (%)	60	No. of CCTs	1
Ground Speed (knots)	100	Scan of Speed (rps)	25
Time Flown (GMT)	1215-1219	Tape Footage	334
Research Team Availability	-	"S" Bend Correction	Yes

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

DETAILS OF AREAS SURVEYED
NERC 1982 SURVEY

Area No. and Name	22 Bristol Channel	Map Sheet Nos.	159, 17(
Flying Height (metres)	12,300 ft & 4000m	Direction Flown	N & S
Flight Conditions	very hazy	No. of Lines	7
No. of 9"x 9"photo prints	44	No. of Scan Lines	25,400
Film Forward Overlap (%)	60	No. of CCTs	8
Ground Speed (knots)	100	Scan Speed rps	12.5
Time Flown (GMT)	1321-1431	Tape Footage	1260
Research Team Availability	Yes	"S" Bend Correction	Yes

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

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Area No. and Name	24 Windermere	Map Sheet Nos.	90, 97
Flying Height (metres)	800	Direction Flown	NW
Flight Conditions	Clear and some cloud	No. of Lines	2
No. of 9" x 9" photo prints	43	No. of Scan Lines	13,900
Film Forward Overlap (%)	60	No. of CCTs	4
Ground Speed (knots)	100	Scan of Speed (rps)	25
Time Flown (GMT)	1430-1452	Tape Footage	711
Research Team Availability	Yes	"S" Bend Correction	Yes

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

DETAILS OF AREAS SURVEYED

NERC 1982 SURVEY

Area No. and Name	25i Gower	Map Sheet Nos.	159
Flying Height (metres)	2000 : 1000	Direction Flown	E & W : E &
Flight Conditions	very hazy : very hazy	No. of Lines	3 : 4
No. of 9"x 9"photo prints	32 : 66	No. of Scan Lines	11,300 : 26,300
Film Forward Overlap (%)	60	No. of CCTs	10
Ground Speed (knots)	100 : 100	Scan Speed rps	12.5 : 25
Time Flown (GMT)	1104-1216	Tape Footage	1868
Research Team Availability	-	"S" Bend Correction	Yes

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

Area No. and Name	25ii Tawe Valley	Map Sheet Nos.	159
Flying Height (metres)	1000	Direction Flown	SW
Flight Conditions	very hazy	No. of Lines	1
No. of 9" x 9" photo prints	12	No. of Scan Lines	3,000
Film Forward Overlap (%)	60	No. of CCTs	1
Ground Speed (knots)	100	Scan of Speed (rps)	25
Time Flown (GMT)	1453-1456	Tape Footage	172
Research Team Availability	-	"S" Bend Correction	Yes

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

DETAILS OF AREAS SURVEYED

NERC 1982 SURVEY

Area No. and Name	25iii Crai	Map Sheet Nos.	160
Flying Height (metres)	2000	Direction Flown	SW
Flight Conditions	very hazy	No. of Lines	1
No. of 9"x 9"photo prints	7	No. of Scan Lines	1500
Film Forward Overlap (%)	60	No. of CCTs	1
Ground Speed (knots)	100	Scan Speed rps	12.5
Time Flown (GMT)	1235-1237	Tape Footage	72
Research Team Availability	-	"S" Bend Correction	Yes

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

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Area No. and Name	26 Lathkilldale	Map Sheet Nos.	119 : refly 119
Flying Height (metres)	1100 : 1000	Direction Flown	W
Flight Conditions	clear : very hazy	No. of Lines	1 : 2
No. of 9" x 9" photo prints	5 : 16	No. of Scan Lines	1500 : 3,700
Film Forward Overlap (%)	60 : 60	No. of CCTs	2
Ground Speed (knots)	100 : 100	Scan of Speed (rps)	25 : 25
Time Flown (GMT)	1108-1110 : 1427-1436	Tape Footage	165 : 187
Research Team Availability	No : Yes	"S" Bend Correction	Yes

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

DETAILS OF AREAS SURVEYED

NERC 1982 SURVEY

Area No. and Name	34 Wymondham	Map Sheet Nos.	134, 155
Flying Height (metres)	2000	Direction Flown	E & W
Flight Conditions	clear	No. of Lines	4
No. of 9"x 9"photo prints	36	No. of Scan Lines	11,000
Film Forward Overlap (%)	60	No. of CCTs	4
Ground Speed (knots)	100	Scan Speed rps	12.5
Time Flown (GMT)	1242-1310	Tape Footage	516
Research Team Availability	-	"S" Bend Correction	Yes

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

Area No. and Name	39i Severn Estuary	Map Sheet Nos.	171
Flying Height (metres)	2000	Direction Flown	SW
Flight Conditions	very hazy	No. of Lines	2
No. of 9" x 9" photo prints	24	No. of Scan Lines	6,400
Film Forward Overlap (%)	60	No. of CCTs	2
Ground Speed (knots)	100	Scan of Speed (rps)	12.5
Time Flown (GMT)	1254-1318	Tape Footage	322
Research Team Availability	-	"S" Bend Correction	Yes

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

DETAILS OF AREAS SURVEYED

NERC 1982 SURVEY

Area No. and Name	39ii Wash	Map Sheet Nos.	131, 132
Flying Height (metres)	2000	Direction Flown	NW/SE
Flight Conditions	haze	No. of Lines	2
No. of 9"x 9"photo prints	-	No. of Scan Lines	9,200
Film Forward Overlap (%)	60	No. of CCTs	2
Ground Speed (knots)	100	Scan Speed rps	12.5
Time Flown (GMT)	1512-1538	Tape Footage	456
Research Team Availability	-	"S" Bend Correction	-

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

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Area No. and Name	40 Norton Lindsey	Map Sheet Nos.	139, 151
Flying Height (metres)	2000	Direction Flown	N
Flight Conditions	very hazy	No. of Lines	2
No. of 9" x 9" photo prints	17	No. of Scan Lines	4,400
Film Forward Overlap (%)	60	No. of CCTs	1
Ground Speed (knots)	100	Scan of Speed (rps)	12.5
Time Flown (GMT)	1456-1513	Tape Footage	221
Research Team Availability	-	"S" Bend Correction	Yes

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

DETAILS OF AREAS SURVEYED

NERC 1982 SURVEY

Area No. and Name	4/41i(a) Shapwick A	Map Sheet Nos.	182
Flying Height (metres)	2000	Direction Flown	E & W
Flight Conditions	very hazy	No. of Lines	4
No. of 9"x 9"photo prints	31	No. of Scan Lines	10,400
Film Forward Overlap (%)	60	No. of CCTs	3
Ground Speed (knots)	100	Scan Speed rps	12.5
Time Flown (GMT)	1342-1410	Tape Footage	520
Research Team Availability	-	"S" Bend Correction	-

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

Area No. and Name	4/41i(b) Shapwick B	Map Sheet Nos.	182
Flying Height (metres)	800	Direction Flown	NW/SE
Flight Conditions	very hazy	No. of Lines	4
No. of 9" x 9" photo prints	39	No. of Scan Lines	11,800
Film Forward Overlap (%)	60	No. of CCTs	4
Ground Speed (knots)	100	Scan of Speed (rps)	25
Time Flown (GMT)	1537-1600	Tape Footage	568
Research Team Availability	-	"S" Bend Correction	-

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

DETAILS OF AREAS SURVEYED

NERC 1982 SURVEY

Area No. and Name	4/41ii Gedney Hill	Map Sheet Nos.	131, 142
Flying Height (metres)	2000	Direction Flown	NE/SW
Flight Conditions	haze	No. of Lines	6
No. of 9"x 9"photo prints		No. of Scan Lines	15,300
Film Forward Overlap (%)	60	No. of CCTs	5
Ground Speed (knots)	100	Scan Speed rps	12.5
Time Flown (GMT)	1345-1445	Tape Footage	944
Research Team Availability	-	"S" Bend Correction	-

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

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Area No. and Name	4/41iii Chatteris	Map Sheet Nos.	143
Flying Height (metres)	4000	Direction Flown	NE/SW
Flight Conditions	very hazy	No. of Lines	8
No. of 9" x 9" photo prints	47	No. of Scan Lines	25,200
Film Forward Overlap (%)	60	No. of CCTs	6
Ground Speed (knots)	100	Scan of Speed (rps)	12.5
Time Flown (GMT)	1601-1730	Tape Footage	1369
Research Team Availability	-	"S" Bend Correction	-

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

DETAILS OF AREAS SURVEYED

NERC 1982 SURVEY

Area No. and Name	4/41iv Strumpshaw	Map Sheet Nos.	134
Flying Height (metres)	4000	Direction Flown	NW/SE
Flight Conditions	clear	No. of Lines	5
No. of 9"x 9"photo prints	33	No. of Scan Lines	12,100
Film Forward Overlap (%)	60	No. of CCTs	4
Ground Speed (knots)	100	Scan Speed rps	12.5
Time Flown (GMT)	1414-1502	Tape Footage	630
Research Team Availability	-	"S" Bend Correction	-

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

Area No. and Name	43i Broads	Map Sheet Nos.	134
Flying Height (metres)	4000	Direction Flown	N & S
Flight Conditions	clear	No. of Lines	4
No. of 9" x 9" photo prints	24	No. of Scan Lines	10,500
Film Forward Overlap (%)	60	No. of CCTs	4
Ground Speed (knots)	100	Scan of Speed (rps)	12.5
Time Flown (GMT)	1335-1403	Tape Footage	493
Research Team Availability	-	"S" Bend Correction	-

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

DETAILS OF AREAS SURVEYED
NERC 1982 SURVEY

Area No. and Name	Conington Airfield	Map Sheet Nos.	142
Flying Height (metres)	500 to 3000 in 500s	Direction Flown	E
Flight Conditions	Haze	No. of Lines	6
No. of 9"x 9"photo prints	17	No. of Scan Lines	2,900
Film Forward Overlap (%)	60	No. of CCTs	1
Ground Speed (knots)	100	Scan Speed rps	12.5 25
Time Flown (GMT)	1605-1627	Tape Footage	135
Research Team Availability	-	"S" Bend Correction	-

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

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Area No. and Name	Map Sheet Nos.
Flying Height (metres)	Direction Flown
Flight Conditions	No. of Lines
No. of 9" x 9" photo prints	No. of Scan Lines
Film Forward Overlap (%)	No. of CCTs
Ground Speed (knots)	Scan of Speed (rps)
Time Flown (GMT)	Tape Footage
Research Team Availability	"S" Bend Correction

Aircraft	Scottish Aviation Pioneer G-AZJH
Camera	Wild RC9 Wide Angle 3.5" Wild lens
Scanner	Daedalus AADS 1268 11 channel Thematic Scanner with AADS 1840 film converter unit and Sabre III tape recorder

TABLE 1

Original Contractual Flying Specification

Weather Restrictions to Flying Programme

1. Cloud - Sites can be flown in cloud free or under a complete cloud cover. For cloud free up to 5% patchy cloud or shadow can be allowed.

   For patchy cloud the site should not be flown without clearance from the NERC project co-ordinator.

   Sites should not be flown without clearance where the overall luminescence is constantly varying.

2. Precipitation - No restriction due to recent rain is necessary.

3. Wind - Whilst calm conditions are preferable the limiting factor is likely to be turbulence effects on the aircraft.

4. Haze/Visibility - In hazy conditions the scanner operator/crew will be responsible for advising on the likely effect and which channels will be affected. The NERC co-ordinator will then decide. In low light conditions the scanner operator must decide if he can record a satisfactory signal by adjusting the gain.

5. Time - Ideally all flying between 9.30 and 16.00 hours. However if we get clear mornings and/or clear evenings the NERC co-ordinator in conjunction with the crew may alter this.

General

If the aircraft flies and the weather closes in the principal of flying a target and see should be adopted rather than returning empty handed.

Preferred Timings/requirements

Attached is a list of timings and requirements of the experimeters. The radio sets will go to groups 22 and 4/41.

"S" Bend Corr	Expt	Preferred Date	Preferred time	Unacceptable date/time	A to G Comms	Photos
Yes	2 (i)	Any	13-1600 hrs	None	No	No
Yes	(ii)	Any	13-1600 hrs	None	No	No
Yes	22	Any	Prefer low water ±3 hrs	Any	Yes	Yes
Yes	25 (i)	But will accept any	Swansea LW ±1.5 hrs	Not outside the low tide limit	No	Yes in stereo
Yes	(ii)	Any	1030-1530 hrs	None		Yes
Yes	(iii)	Any	1030-1530 hrs	None		Yes
Yes	34	Any	1100-1500 hrs	None	No	Yes stereo

Yes	39	(i)	17-20 Sept	Low water ±1hr (see AH)	Will accept ordinary lows ±½hr ?Not outside these		Yes
		(ii)	17-20 Sept	Low water ±1hr (see AH)			
Yes	40		Any	1100-1500 hrs	None	No	Yes
?	4/4	(i)	Any	9.30-1200 hrs	None	Yes	Yes
?		(ii)	Any	9.30-1200 hrs	None	Yes	Yes
?		(iii)	Any	9.30-1200 hrs	None	Yes	Yes
?		(iv)	Any	9.30-1200 hrs	None	Yes	Yes
	43	(i)	Any	9.30-1200 hrs	None	No	Yes stere
Yes		(ii)	Any	9.30-1200 hrs	None	No	Yes stere
Yes	24		Any	Any	None	No	Yes
Yes	26		Any	1100-1500 hrs	None	No	Yes

Note Photography - 30% forward overlap unless stated otherwise - 60% if stereo requested

Radios

(i) Can the crew transmit on the aircraft radio so that field teams can listen? If so what frequency/channel is used. They should transmit whilst on target and at the end.

(ii) The two way radios should be used as needed.

(iii) Radio silence should be observed with the scanner on and the transponder should be off. These affect the data recording.

Area Covered

The scanner should be switched on for the minimum amount of recording to save data processing.

24 August 1982

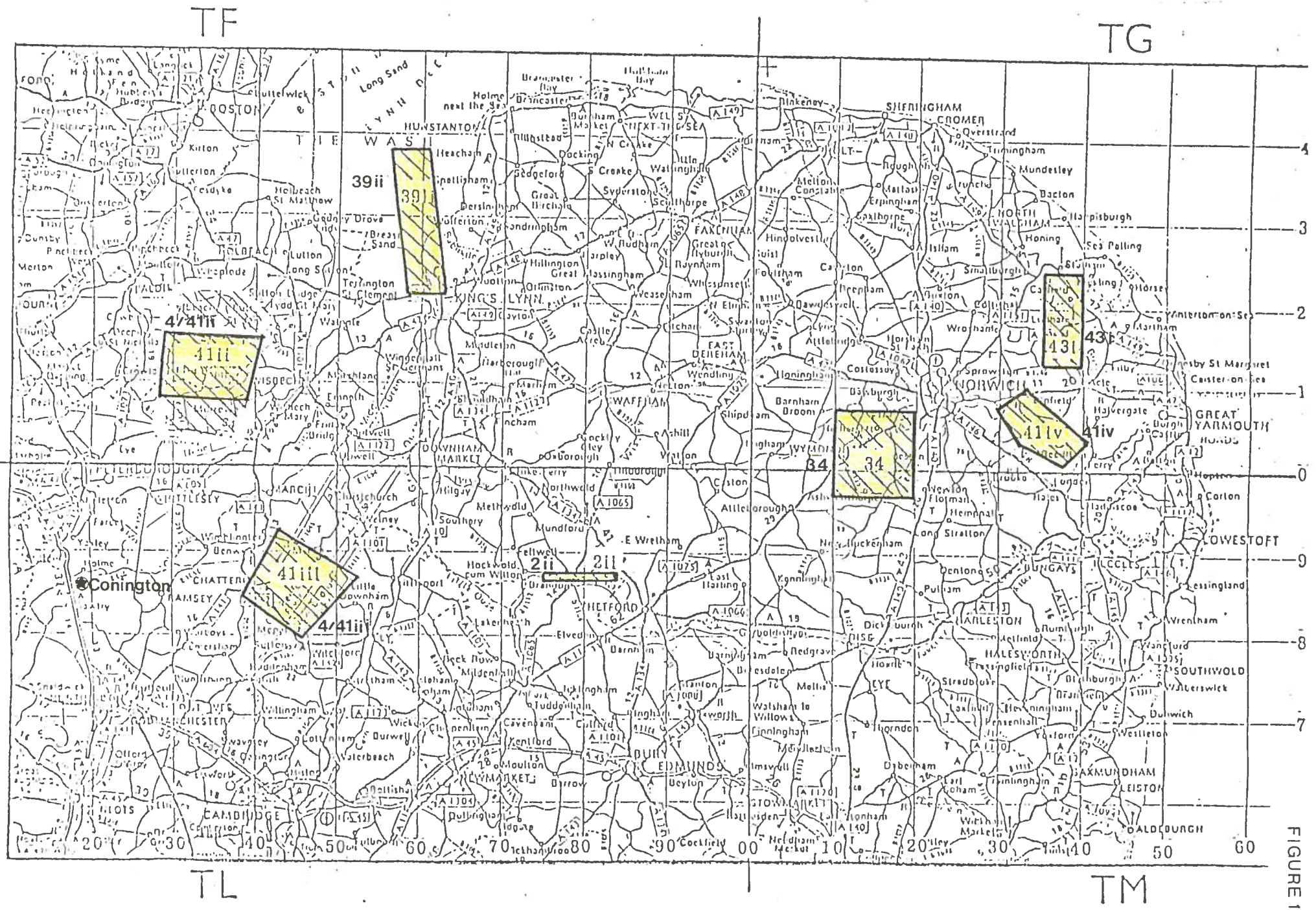

TF
TG
TL
TM
NORFOLK AREAS
39ii
39i
4/41ii
41ii
41iii
4/41ii
2ii
2i
34
43i
41iv
41iv
Conington
BOSTON
HUNSTANTON
KINGS LYNN
WELLS-NEXT-THE-SEA
SHERINGHAM
CROMER
NORTH WALSHAM
NORWICH
GREAT YARMOUTH
LOWESTOFT
THETFORD
BURY ST EDMUNDS
NEWMARKET
ELY
CAMBRIDGE
DISS
HALESWORTH
SOUTHWOLD
FAKENHAM
EAST DEREHAM
WATTON
SWAFFHAM
DOWNHAM MARKET
LITTLEPORT
HADLEIGH
LEISTON
SAXMUNDHAM
ALDEBURGH
Long Sand
WASH
NORFOLK

FIGURE 1

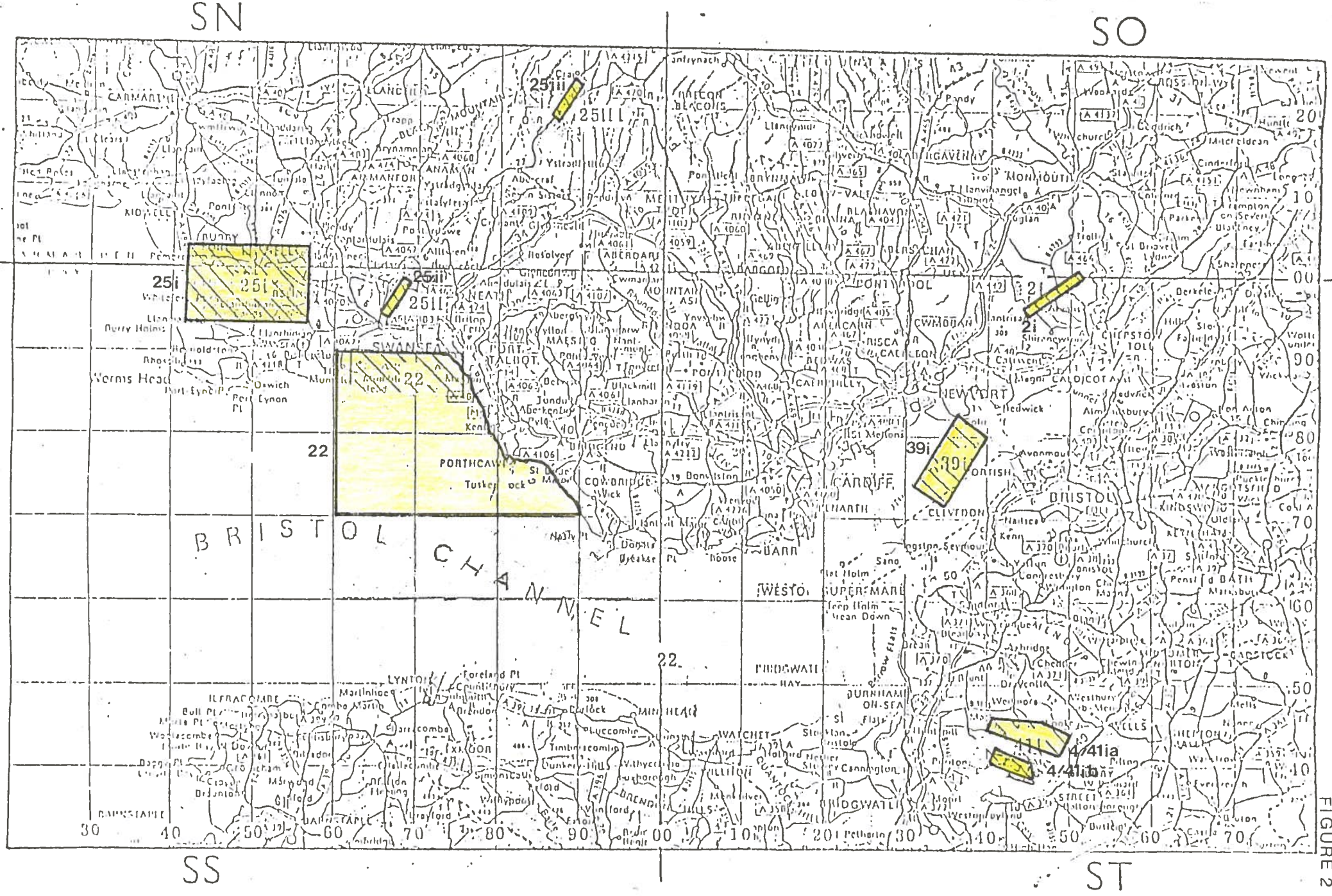

SN
SO
SS
ST
SWANSEA AREAS
BRISTOL CHANNEL
25i
25ii
22
39i
2i
4/41ia
4/41ib
SWANSEA
PORTHCAWL
CARDIFF
NEWPORT
BRISTOL
WESTON SUPER MARE
BURNHAM ON SEA
MINEHEAD
LYNTON
ILFRACOMBE
BARNSTAPLE
22.

FIGURE 2

FIGURE 3


Expt 24
WINDERMERE
Bowness on Windermere
Hawkshead
NETHER STAVELEY
CROSTHWAITE
Red Nab
Queen Adelaide's Hill
Calgarth Park
Belle Isle
Rawlinson Nab
Grass Holme
Great Green Holme
Blind Holme Plantation
Curtis Holme
Lady Holme
Thompson's Holme
Ramp Holme
Ellerwood
Lindeth Howe
Cockshott Point
Ferry House
Ferry Nab
Cockshott Plantation
Belle Isle Plantation
Calgarth Plantation
Lakeside
Storrs Hall
Storrs Hall Estate
Undermillbeck
Calgarth
Cappelbarrow
Winder Hall
Lindeth Howe
Mitchelland
Spigot Ho
Eastern Fidler
Gilpin Mill
Gilpin
Lowfold
Low Fold
Crook Hall
Crook End
Crook Ho
Glen
Wainrigg
Lindeth Howe Country House Hotel
Lakeside Hotel
Belsfield
Belsfield Ho
Belsfield Plantation
Cockshott Plantation
Low Wray
Wray Castle
Wray Castle Plantation
Low Wray Campsite
Ferry Ho
Ferry Nab
Sawrey
Near Sawrey
Far Sawrey
Esthwaite Hall
Esthwaite Lodge
Esthwaite Fell
Esthwaite Water
Hawkshead Hall
Hawkshead Hill
Hawkshead Town End
Hawkshead Grammar School
Hawkshead Church
Hawkshead Priory
Hawkshead Campsite
Hawkshead Brewery
Hawkshead Ho
Hawkshead Hall Farm
Hawkshead Hall Plantation
Hawkshead Hall Wood
Hawkshead Hall Estate
Hawkshead Hall Estate Office
Hawkshead Hall Estate Office
Hawkshead Hall Estate Office

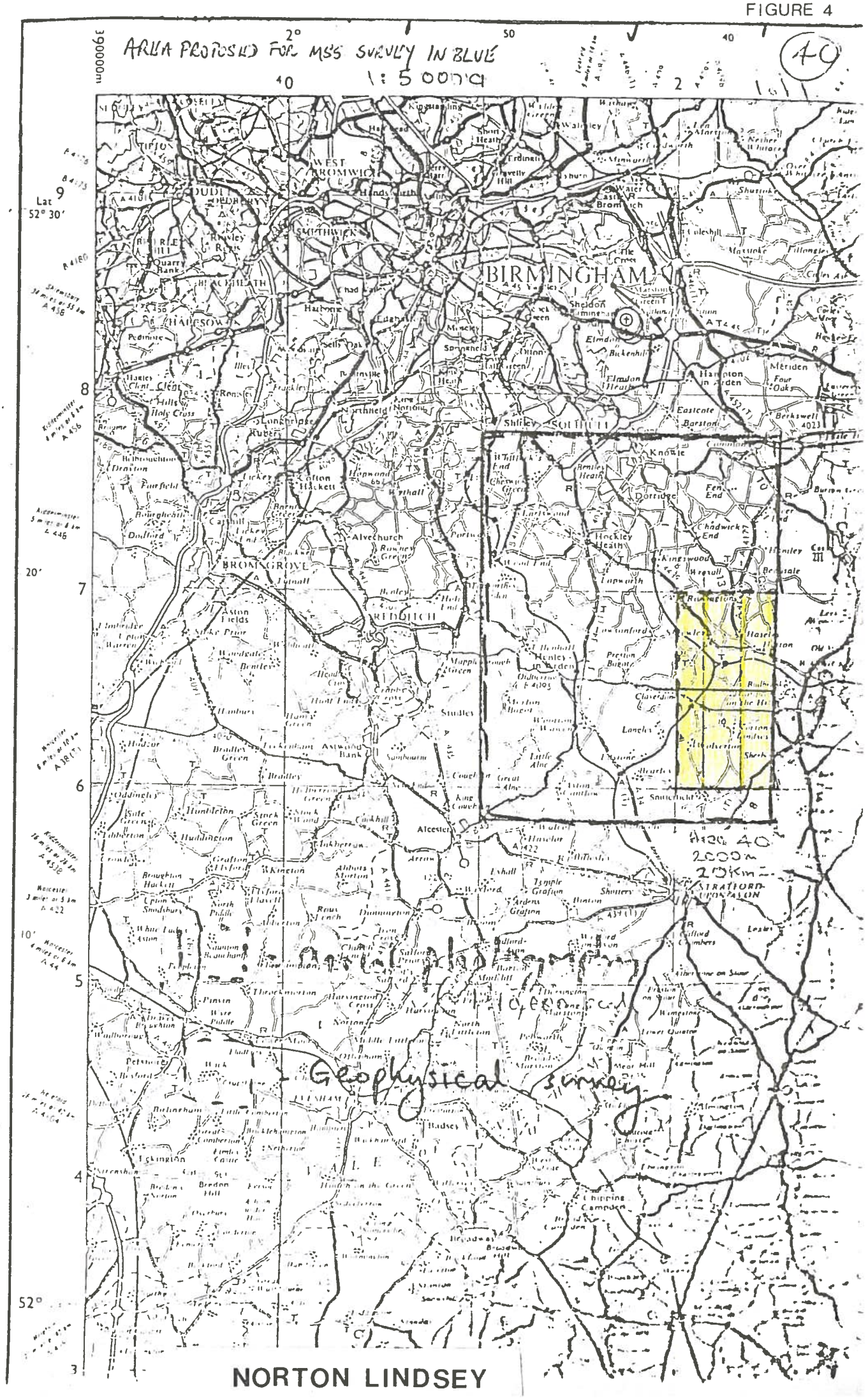
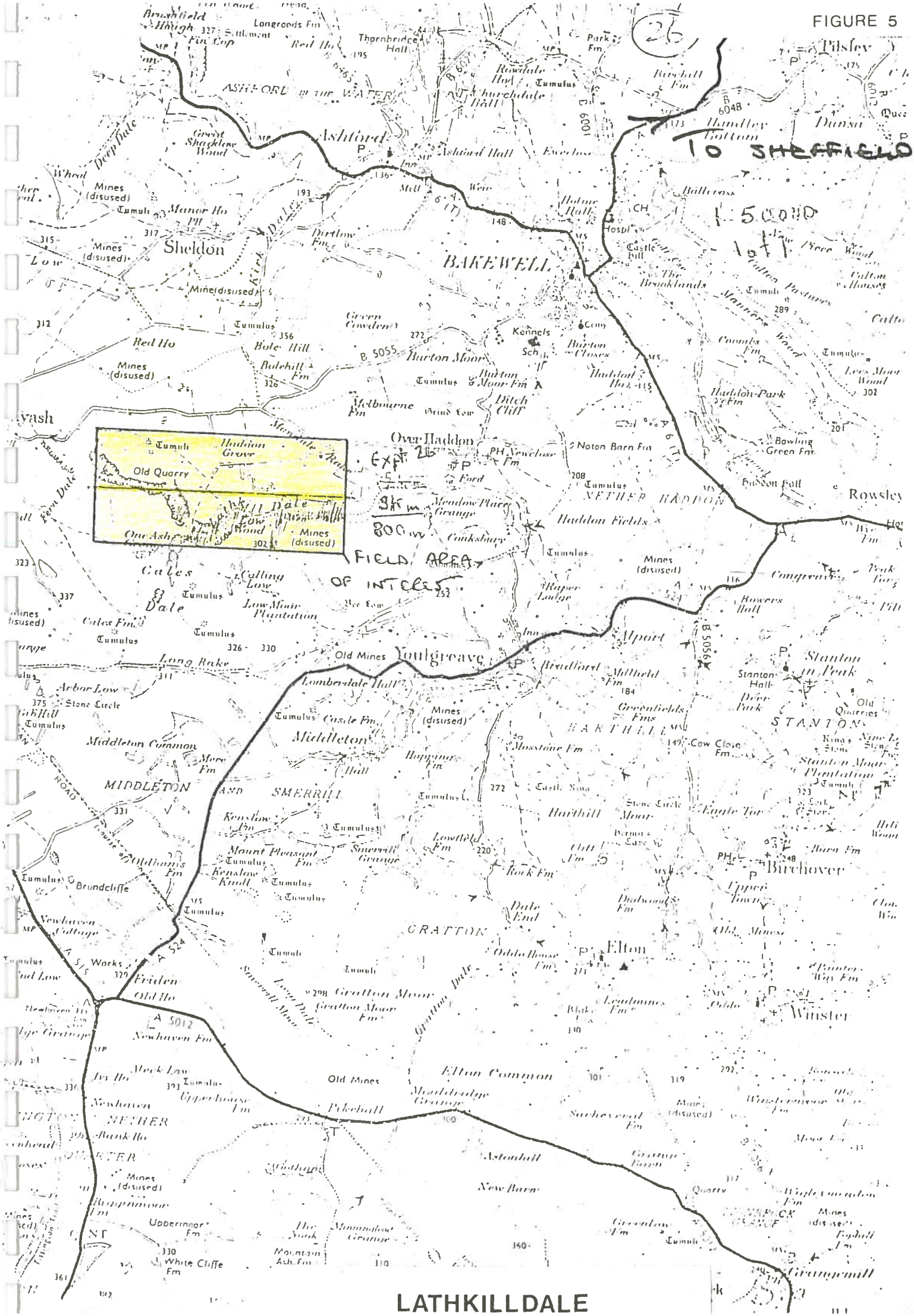
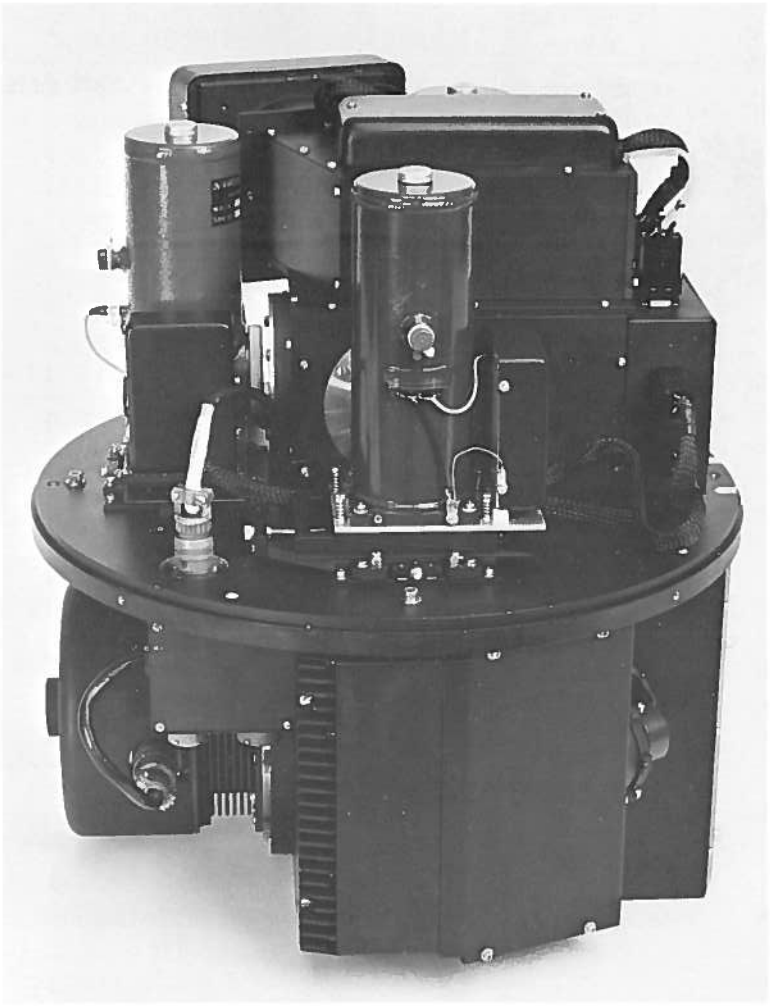

AREA PROPOSED FOR MSS SURVEY IN BLUE
1:50000
40
Area 40
2000m
20Km²
Geophysical Survey
NORTON LINDSEY

FIGURE 5



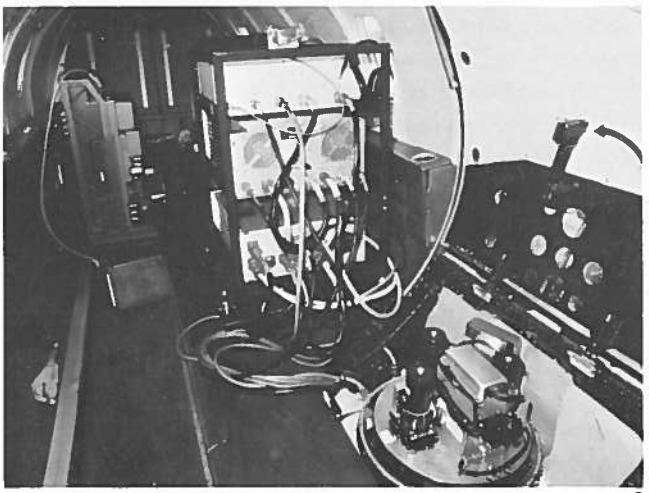
Daedalus Introduces the Airborne Thematic Mapper

ATM
AADS1268



1

2



3

Daedalus introduces a totally new scan head (Figure 1) to acquire data in the NASA-selected thematic mapper bands and to achieve a highly versatile foundation for the multi-spectral research requirements of the 1980's. A new Daedalus system (designated the AADS1268), Airborne Thematic Mapper (ATM), combines this state of the art scan head with proven electronic assemblies of the AADS1260 system.

The prototype scan head was flown operationally for the first time in October 1981, during an extensive high altitude data acquisition program in the western United States. The data acquisition program covered 91,000 square kilometers and was conducted for 13 energy and mining companies.

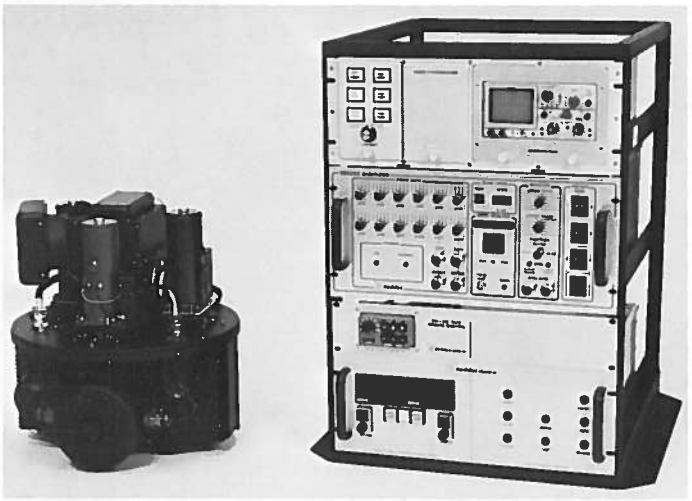
A Learjet 25 (Figures 2 & 3), operated by Capital Air Surveys of Canada and equipped with a specially modified aircraft door to accommodate the scan head, was employed for the survey.

At an altitude of 12.5 kilometers, the ATM spatial resolution of 2.5 milliradians produces approximately the same pixel size as the Landsat-D Thematic Mapper (30 meters x 30 meters).

DAEDALUS ENTERPRISES, INC. P.O. Box 1869, Ann Arbor, Michigan 48106 TELEX 230530

daedalus

Daedalus AIRBORNE THEMATIC MAPPER...



AADS1268 ATM Scan Head and Electronics Rack.

Sophisticated image processing of ATM data collected over semiarid terrain enables geologists to obtain important new information for petroleum and mineral exploration. Whereas properly processed Landsat 1, 2, and 3 data can be used to map iron oxides, ATM can be used to segregate iron oxides into primary and secondary categories, as well as to map surface exposures of clay minerals. Since both secondary iron oxides and clay minerals are associated with basic metal deposits, the ATM offers exciting new capabilities for gold, silver, uranium, copper, lead, zinc, and other metal exploration. It also offers new capabilities for mapping surface soil alterations and vegetative anomalies which are sometimes related to ancient oil and gas seeps. †

†For more information and examples of color imagery related to this program, please refer to pages 24 and 25 of "Daedalus Scanner Applications . . . Worldwide 1981."

Daedalus customers who own AADS1260 Digital MSS Systems can convert to an AADS1268 ATM configuration; however, this configuration must be accomplished at the Daedalus facilities in Ann Arbor, Michigan , U.S.A.

Major improvements offered in the new AADS1268 are:

1. Versatile optical design, which can accommodate a great variety of combinations of spectrometer configurations as future needs arise.
2. Precise registration of pixels from all channels.
3. Combination of spectral bands, e.g., thematic mapper bands, not previously achievable.
4. Optional 1.25 mr IFOV field stop aperture assembly.
5. Larger collecting areas for improved radiometric sensitivity.
6. Higher performance optics and coatings.
7. Improved optical/mechanical design incorporating thermally stable materials.
8. Improved laboratory calibration equipment.

The first production AADS1268 was delivered to NASA/Ames in March 1982, as a modification of their AADS1260 system, for 1.25 mrad operation in their Lockheed ER-2 high altitude research aircraft.

The principal AADS1268 system specifications for a 2.5 mrad configuration are as follows:

OPERATING WAVELENGTHS AND PERFORMANCE PARAMETERS

Channel Band Edges in µm	12.5 scans/sec.		50 scans/sec.	
	NER ①	NEΔρ②	NER ①	NEΔρ②
0.42 — 0.45	<0.50	0.25	<1.0	<0.5
*0.45 — 0.52	<0.20	0.10	<0.5	<0.2
*0.52 — 0.60	<0.30	0.10	<0.5	<0.2
0.605— 0.625	<0.60	0.25	<1.0	<0.4
*0.63 — 0.69	<0.20	0.06	<0.3	<0.1
0.695— 0.75	<0.30	0.20	<0.5	<0.3
*0.76 — 0.90	<0.15	0.15	<0.3	<0.3
0.91 — 1.05	<0.30	0.30	<0.5	<0.5
*1.55 — 1.75	<0.15	0.30	<0.3	<0.7
*2.08 — 2.35	<0.10	0.70	<0.2	<1.4
*8.5 —13.	<0.2°C	NEΔT③	<0.3°C	NEΔT③

* Thematic Mapper Bands, except thermal band broadened for aircraft operation.

① Noise Equivalent Radiance in w x 10^{-7} • cm^{-2} • nm^{-1} sr^{-1}.

② Noise Equivalent Reflectance Change, P. Moon Value: Ref: NASA Tech. Paper #1575, Dec. 1979.

③ Noise Equivalent Temperature Change.

Instantaneous Field of View (IFOV)	2.5 mrad (1.25 mrad optional)
Digitized Field of View	85.92° (2.5 mr IFOV) or 42.96° (1.25 mr IFOV)
Scan Rate	12.5; 25; 50 scans/sec.
Velocity/Height Ratio	0.031; 0.062; 0.125 radians/sec. corresponding to 12.5; 25; and 50 scans/sec., respectively (2.5 mr IFOV)
Roll Correction	±15°
Infrared Reference Source.	2 controllable thermal blackbodies with a temperature range of −15°C to +50°C with respect to scan head heat sink temperature.

If you have a question regarding Daedalus products and services, please contact our office through the sales manager assigned to your area:

North America, Central & South America—Thomas R. Ory
Europe & Africa— Peter K. Pleitner
Southeast Asia— Arthur A. Arro

Daedalus Enterprises, Inc. Telex—230530
P.O. Box 1869
Ann Arbor, MI 48106 Phone—313/769-5649

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